UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: March 2022

Module Number: CE 7255   Module Name: Irrigation Engineering (TE)

[Three Hours]

[Answer **all questions**, each question carries fifteen marks]

Q1. a) Explain the significance of the following soil moisture levels for crop growth.
   i) Field capacity.
   ii) Permanent wilting point.

   [1.5 + 1.5 Marks]

   b) The following data pertain to a vegetable crop cultivated in a farm land.
   Available soil moisture   = 140 mm/m
   Root zone depth of crop = 60 cm
   Daily consumptive use of water by crop = 12 mm
   Field application efficiency = 0.6

   In order to ensure optimum growth of the crop, calculate the following assuming an allowable moisture depletion of 40% from the available soil moisture.
   i) Frequency of irrigation.
   ii) Depth of irrigation application.

   [2.0 + 2.0 Marks]

   c) Drainage management and salinity control are important elements in sustainable irrigated agriculture. Discuss the importance of the following, highlighting their impacts on agricultural productivity and environment.

   i) Having a proper drainage system in an irrigation scheme.

   ii) Controlling salinity in an irrigation scheme.

   [2.0 + 2.0 Marks]

   d) In irrigated agriculture, maintaining the soil fertility by natural means has become popular in the recent past. In this context, discuss the importance of practicing 'crop rotation' and 'intercropping'.

   [4.0 Marks]

Q2. a) i) 'Crop coefficient is used to account for the effect of crop characteristics on the crop water requirements'. In this statement, what is meant by the term 'crop coefficient'?
   ii) Discuss the accuracy of irrigation requirement estimates based on the concept of crop coefficient.

   [2.0 + 3.0 Marks]

   b) Actual crop water requirement depends on several local factors. Describe how the local factors given below affect the crop water requirement.
   i) Method of irrigation.
   ii) Cultural practices.

   [3.0 + 3.0 Marks]

c) In developing a small-scale irrigation scheme, evaporation was measured onsite using a *Class A* pan and it gave a value of 11.5 mm/day for the month of February. The pan station was located in a middle of 350 m x 350 m fallow area. At the pan station, mean relative humidity of 40-70% and wind speed of 210 km/day were recorded. Determine the mean ET_0 at the pan station for the month of February.

In the pan evaporation method, recommended relationship for ET_0 and E_{pan} is as follows:

$$ET_0 = K_p \times E_{pan}$$

where;
ET_0 = reference crop evaporation in mm/day
E_{pan} = pan evaporation in mm/day
K_p = pan coefficient

You may use the data given in Table Q2 for your calculations. State any assumptions you make.

[4.0 Marks]

Q3. a) When selecting a particular irrigation method, irrigation engineer must consider several factors, and choose a method which is best suited to local conditions. What are the factors that need to be considered in selecting an irrigation method?

[3.0 Marks]

b) i) How does basin irrigation become advantageous over free flooding in terms of water application efficiency?

ii) A farmland having sandy loam soil is required to irrigate using the basin irrigation method. How would you adjust 'size' and 'shape' of the basin in order to ensure high water application efficiency and high cultivation efficiency?

[3.0 + 3.0 Marks]

c) Having a fixed irrigation schedule may reduce the water application efficiency of Border method of irrigation. Explain the above statement.

[3.0 Marks]

d) What method of irrigation would you think as suitable for irrigating small fruit trees cultivated in a water scarce area having 'saline' water? Justify your answer.

[3.0 Marks]

Q4. a) i) The design of primary, secondary and tertiary canals requires consideration of number of factors that ensure proper functioning of whole irrigation system'. Explain the factors stated in the above statement.

[2.0 Marks]

ii) Describe the following structures with sketches and explain their operations:
   I) Inverted siphon.
   II) Flow dividing structure.

[2.0 + 2.0 Marks]

b) i) Explain the difference between the 'net irrigation requirement' and the 'actual irrigation requirement'.

    ii) 'Contribution from groundwater' is one of the main factors that affect the irrigation requirement. Explain how it affects the irrigation requirement.

[3.0 + 3.0 Marks]

c) Discuss the inadequacies of present-day canal irrigation management in Sri Lanka and suggest suitable methods of improvement.

[3.0 Marks]

Table Q2: Pan Coefficient (K_p) for *Class A* Pan for Different Groundcover and Levels of Mean Relative Humidity and 24 hour wind.

Class A pan	Case A: Pan placed in short green cropped area				Case B[1] Pan placed in dry fallow area			
RH_{mean} %		low < 40	medium 40-70	high > 70		low < 40	medium 40-70	high > 70
Wind km/day	Windward side distance of green crop m				Windward side distance of dry fallow m			
Light < 175	1	.55	.65	.75	1	.7	.8	.85
	10	.65	.75	.85	10	.6	.7	.8
	100	.7	.8	.85	100	.55	.65	.75
	1 000	.75	.85	.85	1 000	.5	.6	.7
Moderate 175-425	1	.5	.6	.65	1	.65	.75	.8
	10	.6	.7	.75	10	.55	.65	.7
	100	.65	.75	.8	100	.5	.6	.65
	1 000	.7	.8	.8	1 000	.45	.55	.6
Strong 425-700	1	.45	.5	.6	1	.6	.65	.7
	10	.55	.6	.65	10	.5	.55	.65
	100	.6	.65	.7	100	.45	.5	.6
	1 000	.65	.7	.75	1 000	.4	.45	.55
Very strong > 700	1	.4	.45	.5	1	.5	.6	.65
	10	.45	.55	.6	10	.45	.5	.55
	100	.5	.6	.65	100	.4	.45	.5
	1 000	.55	.6	.65	1 000	.35	.4	.45